2020 Chehalis ASRP
Stream-Associated Amphibian Surveys
Interim Progress Report

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This progress report provides an update on stream-associated amphibians surveys conducted in the Chehalis River Basin from 2018 to 2020. Results of the 2018 survey effort were developed into a preliminary report to inform the Chehalis River Basin Flood Damage Reduction Project Environmental Impact Statement (EIS; Hayes et al. 2019). Broadly, this study's objective is to document stream-breeding amphibian occupancy and distribution throughout the Chehalis River Basin.

We seek to:

- Establish a baseline of stream-associated amphibian occupancy and distribution throughout headwater areas where it has not previously been established;
- Describe the relationship between occupancy and stream characteristics known to impact amphibian occupancy and abundance, including elevation, stream order and stream temperature.
- Inform the Chehalis River Basin Flood Damage Reduction Project Environmental Impact Statement

Results will inform effectiveness of current and future restoration actions and the impacts of climate change by providing a baseline to which future occupancy and distribution of target amphibian species can be compared through time. Target species of this work include native stream-associated amphibians: coastal tailed frog (*Ascaphus truei*), Columbia torrent salamander (*Rhyacotriton kezeri*), Olympic torrent salamander (*R. olympicus*), coastal giant salamander (*Dicamptodon tenebrosus*) and Cope's giant salamander (*D. copei*).

STUDY AREA

Our study area encompassed small headwater streams (Strahler order 1st-4th) and medium rivers (Strahler order 5th-7th). The predominant land use in the target area is forestry, with more than 90% of the area managed for timber production or in protection on USFS lands. The remaining 10% is in agricultural production, with scattered residential development.

SITE SELECTION AND FIELD SAMPLING

In 2018 and 2019, we focused the headwaters of the Upper Chehalis River, including the footprint of the proposed dam and reservoir. In 2020, we focused on Stillman Creek, Humptulips River, and Wynoochee River drainages. We used the National Hydrological Database (NHD) to categorize streams by order (Strahler 1957) and sampled them proportional to their occurrence in each drainage. In 2018 & 2019 we also partitioned the target area into four subareas based on their relationship to the footprint: "Above" (upstream on mainstem Chehalis and tributaries), "Below" (downstream), "Into" (flows into footprint) and "Within" (within footprint). We then set a specific target number to sample in each subarea—0.5% of available sites in the "Above", "Below", and "Into" subareas; 2.0% of the sites in the "Within" subarea to allow for increased accuracy when estimating potential losses due to dam construction.

Each site was a 40-m stream reach, within which we distributed 20 sample plots, each 2 m long. Each sample plot was 18 in (~0.5 m) square plot, corresponding to the width of the kick net used for sampling. Previous research has demonstrated that stream-associated amphibian genera were detected with high confidence when approximately 10 m of stream length was surveyed (Quinn et al. 2007). We sampled the downstream most plot first, followed by each subsequent plot moving upstream. If the location of a plot was obstructed (e.g., dense woody debris, cliffs) or dry, we did not survey that specific plot. In 2019, each site was surveyed on three consecutive days by a different team to allow for the future estimation of detection probability.

We set a kick net flush with the substrate at the downstream end of each sample plot, physically disturbed the upstream substrate by hand over the 18 in (~0.5 m) length of the plot and allowed water flow to move animals into the net or captured them by hand. We identified each captured animal to species and recorded life stage[1], sex, and gravidity. We photographed a representative of each species at most sites. We obtained a small tail clip for a representative sample of giant salamanders for future genetic identification since coastal and Cope's giant salamanders are difficult to differentiate, especially for larvae in the field. We stored tissue samples in anhydrous ethanol and stored out of sunlight until analysis.

We recorded several physical parameters at each site. At the site end points (0 and 40 m), we recorded a GPS location, weather (as one or two of eight descriptive categories), water temperature, and stream wetted width. At the 0, 20 and 40 m points, we recorded canopy density via spherical densiometer and the two most dominant/subdominant canopy species. We recorded the dominant and subdominant substrate size classes (Udden-Wentworth scale; Blair and McPherson 1999), and functional wood[2] as a visual estimate over the entirety of the 40-m stream reach. We also obtained an elevation (m) and stream order for each site using the 10-m Digital Elevation Model (DEM) and the NHD layer in GIS.

Data were recorded electronically in the field. We checked entered data for accuracy and downloaded data into an Access database with referential integrity mandates and input masks to

[1] Egg, larvae, metamorph, juvenile, adult

[2] Wood that played a role in stream function (Montgomery et al. 1996), which we categorized by count (None, Infrequent [<5], Often [5-20], Frequent [>20]) within four diameter classes (<10 cm, 11-25 cm, 26-50 cm, >50 cm).

ensure quality. Data is stored on WDFW servers that are backed up regularly. All data summaries, figures and maps were created using program R 4.0.2.

SUMMARY OF EFFORT

Over three years, we visited 875 unique sites. In 2018 and 2019 we surveyed April–September, and in 2020 we were delayed to May–October due to the COVID-19 pandemic (**Table 1**). Of all 875 sites, 711 (81.3%) were located on headwater streams and 164 (18.3%) on medium rivers. We met our sample size targets by stream order across all years (**Error! Reference source not found.2**). We detected amphibians at 502 sites, most of which were headwater streams (**Figure 1; Table 3**). In 2019, a smaller number of sites were surveyed on three consecutive sampling visits to enable later detectability analyses; as a result the total number of surveys across the 875 sites was 1,137.

Table 1. Date ranges for all surveys performed in 2018–2020.

Year	Start date	End date	# of days	# of surveys
2018	April 10	September 20	164	376
2019	April 8	September 26	175	393
2020	May 26	October 22	154	368

Table 2. Goal and actual sites surveyed summarized by stream order and year. We had a single 2-year goal for the 2018 and 2019 field seasons.

	2018 & 2019		2020		Overall	
Order	**Goal**	**Actual**	**Goal**	**Actual**	**Goal**	**Actual**
1	75	79	143	157	218	236
2	75	98	51	77	126	175
3	75	121	33	49	108	170
4	75	104	22	26	97	130
5	30	44	21	22	51	66
6	30	30	21	23	51	53
7	30	31	14	14	44	45
Totals	**390**	**507**	**305**	**368**	**695**	**875**

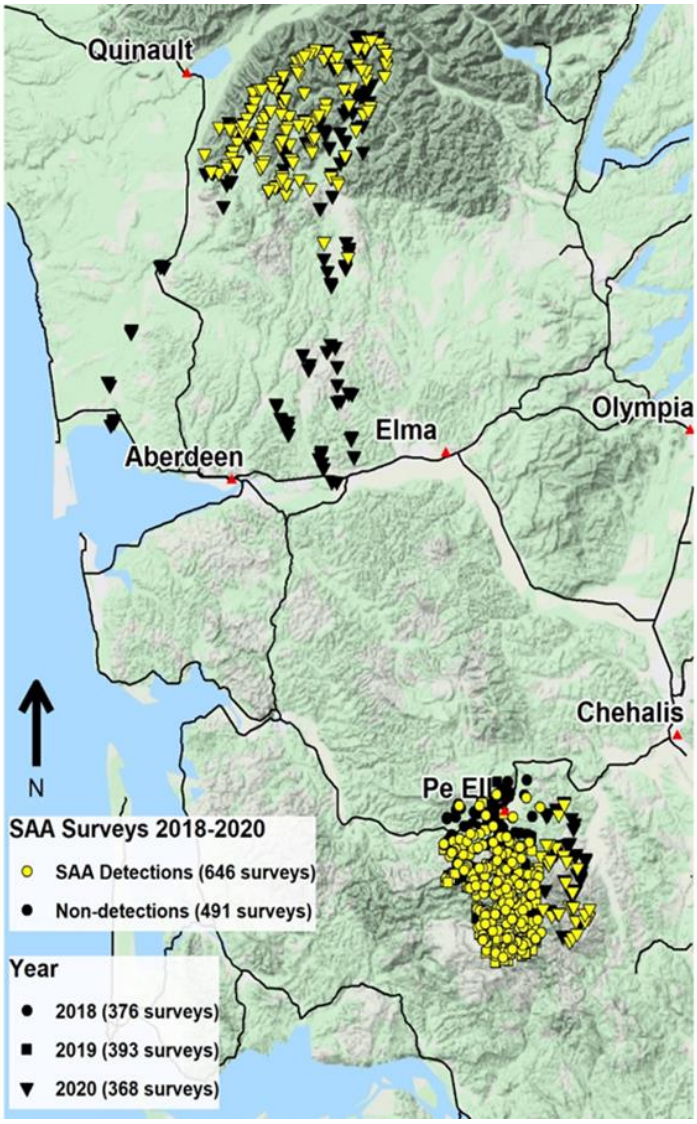

Figure 1. Locations and distribution of stream-associated amphibian surveys conducted in the Chehalis River Basin 2018-2020.

Collectively, we made 4,108 amphibian detections: 36 egg masses, 2,827 larvae, 307 metamorphs, 290 juveniles, 531 adults, and 117 of indeterminate stage. While en route to survey locations, we also incidentally observed 6,336 amphibians: 0 egg masses, 5545 larvae[3], 53 metamorphs, 440 juveniles, 238 adults, and 61 of indeterminate stage.

Most target amphibians occurred throughout the entire study area, or geographically as expected, with some exceptions. Coastal tailed frogs (*Ascaphus truei*) are known throughout the study area and we detected them most frequently in headwater streams (**Figure**), though some were observed

[3] 5,075 larvae were from a single recently hatched egg mass of western toads.

in medium rivers (**Table**). Torrent salamanders are also known from headwater streams, where we observed them exclusively (**Table**), though Olympic and Columbia torrent salamanders occur in the Olympic Mountains and Willapa Hills, respectively (**Figure**). Giant salamanders are also associated with headwater streams, and most of our detections were made in the headwaters, with relatively few detections in medium rivers (**Table**). Our study area includes the ranges of two giant salamander species. Cope's giant salamander is distributed throughout the Chehalis Basin, while coastal giant salamander in the Chehalis is restricted to the Willapa Hills (**Figure 4**). Of our 427 giant salamander observations, 192 and 117 were identified through genetic analysis as Cope's and coastal giant salamander, respectively; 114 were not identified to species; and 4 were identified as hybrids of the two species through genetic analysis. Though the majority of our amphibian observations were for target species, we did observe other species in our study sites including western toad (*Anaxyrus boreas*; n = 10), Pacific tree frog (*Pseudacris regilla*; n = 2), northern red-legged frog (*Rana aurora*; n = 9), Cascades frog (*Rana cascadae*; n = 5), rough-skinned newt (*Taricha granulosa*; n = 3), Dunn's salamander (*Plethodon dunni*; n = 10), western redback salamander (*P. vehiculum*; n = 15), and Van Dyke's salamander (*P. vandykei*; n = 2).

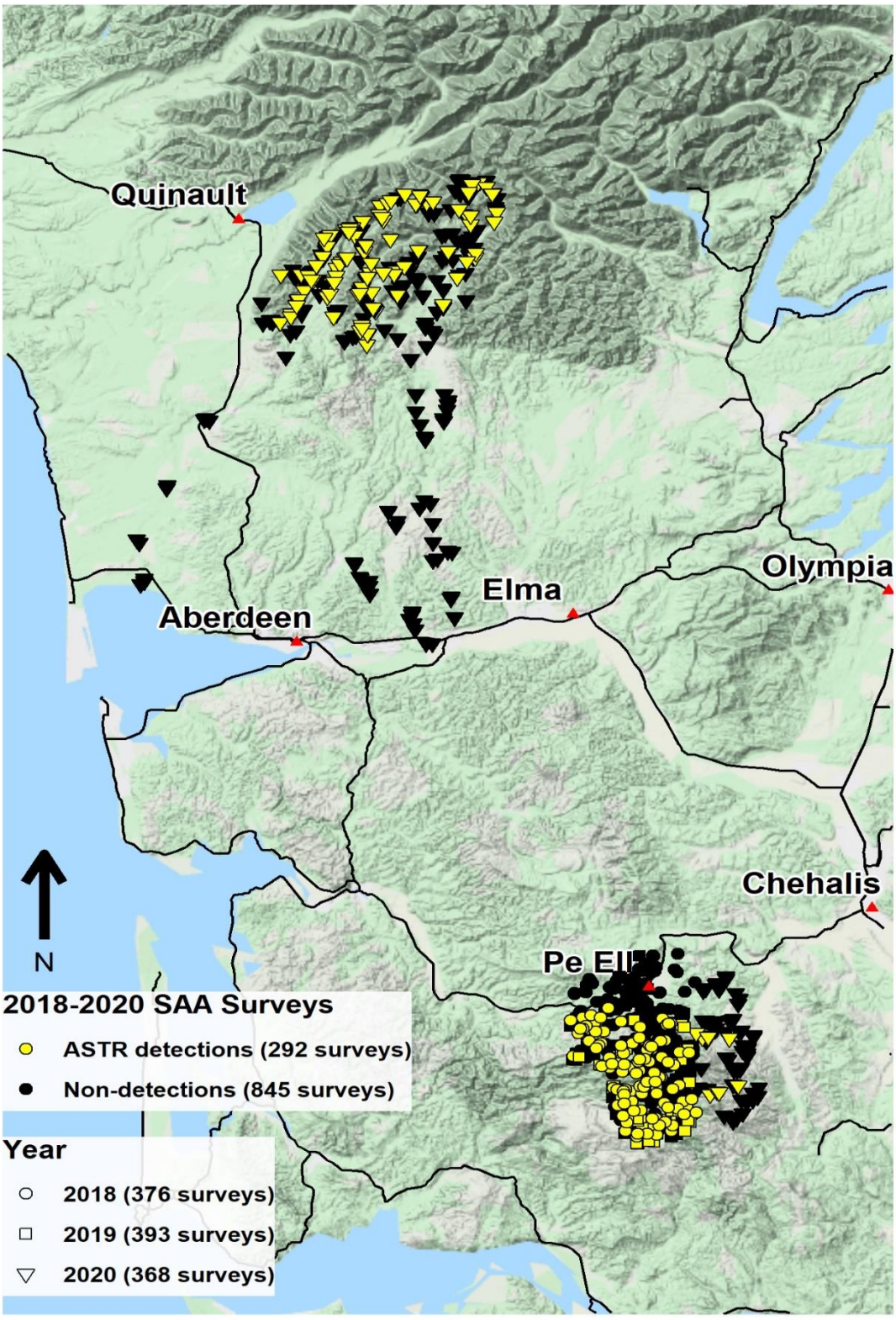

Figure 2. Distribution of coastal tailed frog (ASTR) detections made during stream-breeding amphibian surveys conducted at 875 unique sites in the Chehalis River Basin, 2018-2020.

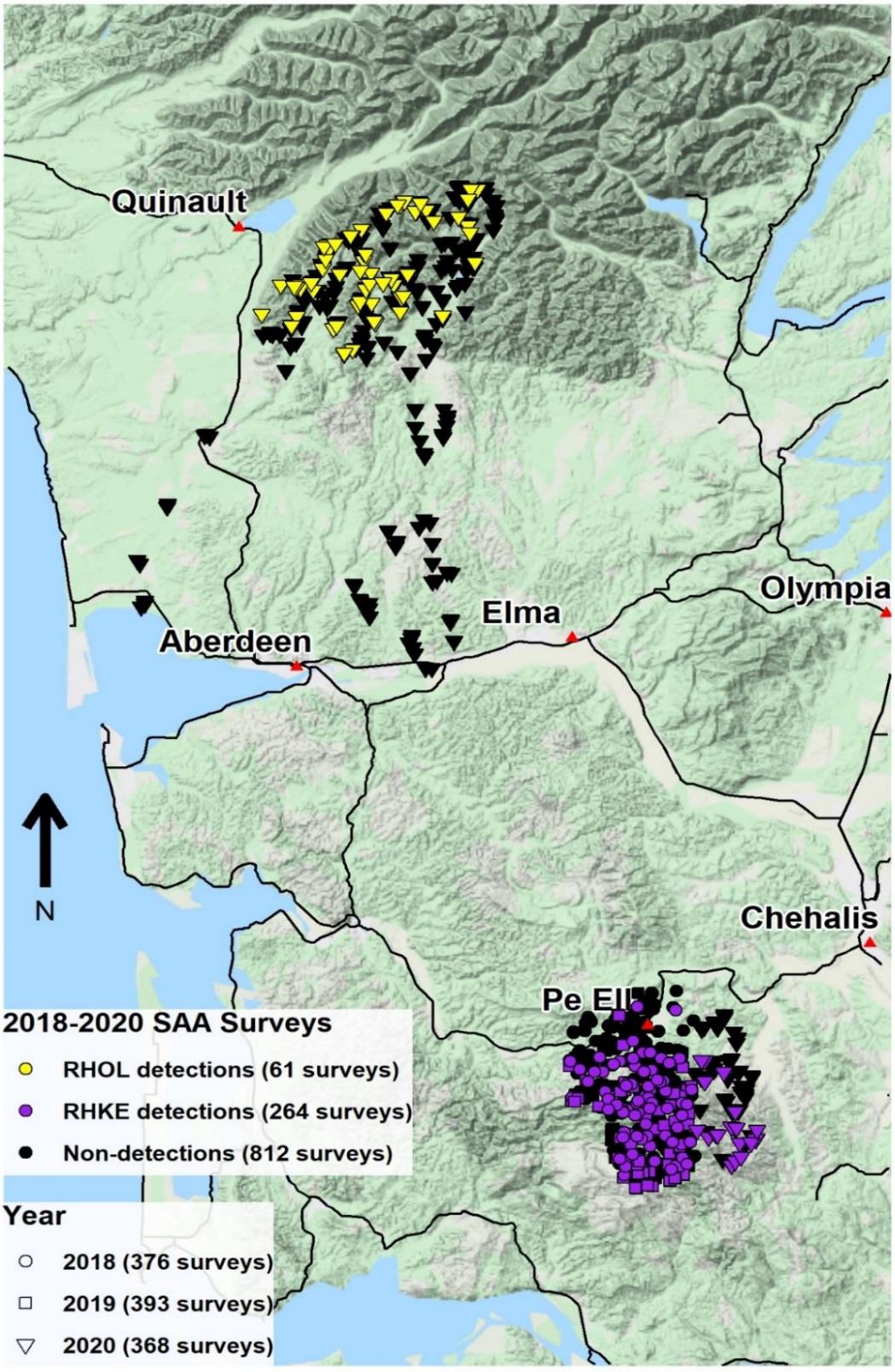

Figure 3. Distribution of Olympic (RHOL) and Columbia torrent salamander (RHKE) detections made during stream-breeding amphibian surveys conducted at 875 unique sites in the Chehalis River Basin, 2018-2020.

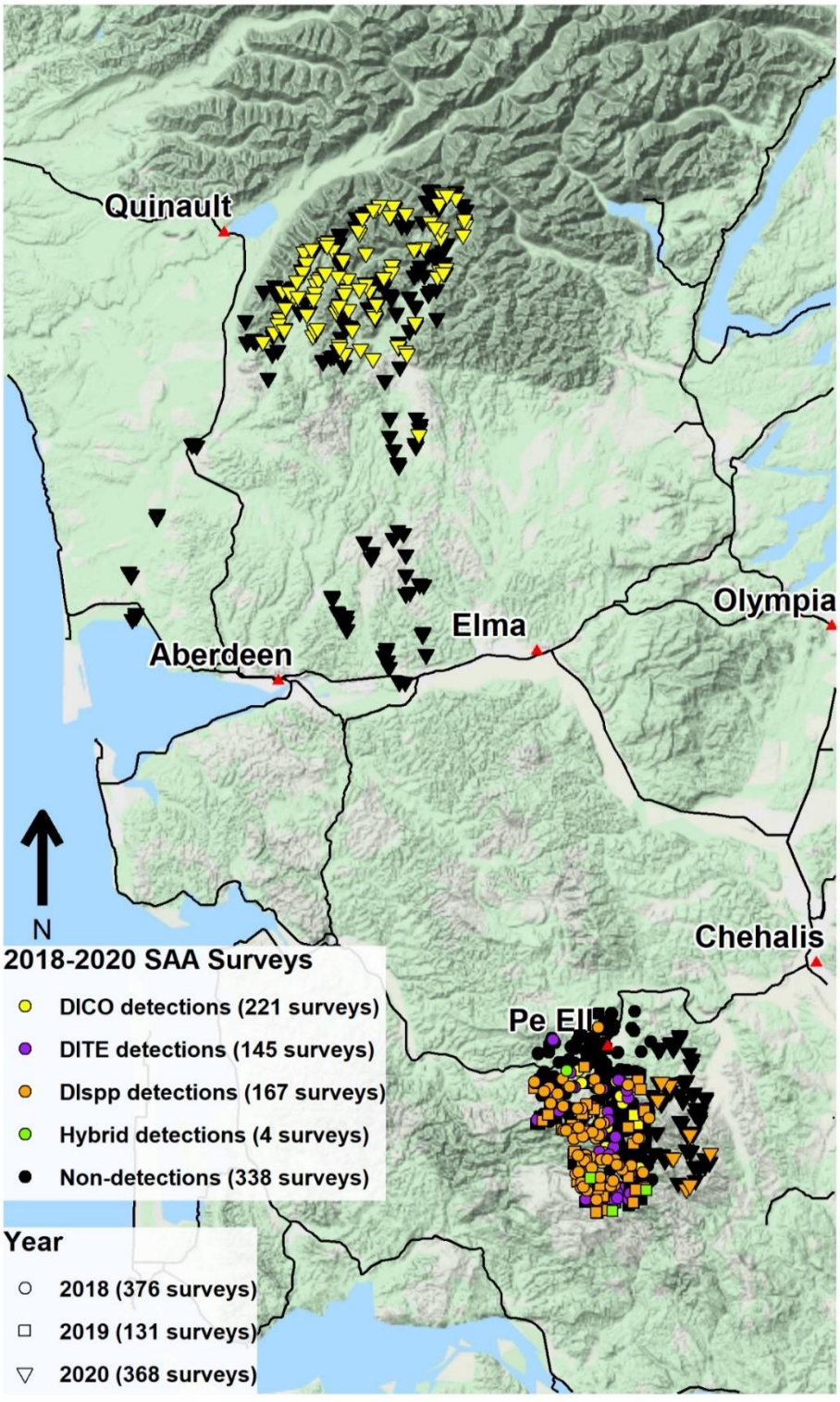

Figure 4. Distribution of giant salamander detections made during stream-breeding amphibian surveys conducted at 875 unique sites in the Chehalis River Basin, 2018-2020. Cope's (DICO) and coastal (DITE) giant salamander were verified with genetic analysis. DIspp indicates individuals unresolvable to species level. Hybrid were hybrids between the two species identified with genetic analysis.

Table 3. Number of sites in which amphibians were detected during 1,137 surveys carried out along 875 stream reaches in the Chehalis basin, 2018-2020. Surveys in 2018-2019 occurred in the Upper Chehalis basin, and in 2020 they occurred in the Humptulips River, Wynoochee River, and Stillman Creek drainages. In 2019, we sampled a smaller number of sites in triplicate to enable future detectability analyses. Year totals (bottom two rows) are not vertically additive due to sites being positive for multiple species. Values are dashed for entries in which no surveys occurred within the species' known ranges and Species of Greatest Conservation Need are noted by *.

	Stream Order																					
Species	**1 '18**	**1 '19**	**1 '20**	**2 '18**	**2 '19**	**2 '20**	**3 '18**	**3 '19**	**3 '20**	**4 '18**	**4 '19**	**4 '20**	**5 '18**	**5 '19**	**5 '20**	**6 '18**	**6 '19**	**6 '20**	**7 '18**	**7 '19**	**7 '20**	**Total**
ASTR	6	16	35	21	12	35	32	4	29	39	7	4	6	6	2	1	1	0	0	0	0	256
DIspp	9	16	3	13	11	5	22	9	1	22	5	0	1	2	0	0	0	0	0	0	0	114
RHKE*	16	44	9	35	19	10	18	7	0	6	3	0	0	0	0	0	0	0	0	0	0	167
RHOL*	-	-	45	-	-	11	-	-	5	-	-	0	-	-	0	-	-	0	-	-	0	61
Sites w/ targets	**22**	**47**	**88**	**47**	**20**	**57**	**60**	**11**	**33**	**53**	**8**	**5**	**7**	**8**	**2**	**1**	**3**	**1**	**0**	**0**	**0**	**473**
All sites	**29**	**50**	**157**	**74**	**24**	**77**	**107**	**14**	**49**	**90**	**14**	**26**	**32**	**12**	**22**	**20**	**10**	**23**	**24**	**7**	**14**	**875**

Species codes: ASTR=coastal tailed frog; DIspp=Cope's, Pacific, or hybrid giant salamanders; RHKE=Columbia torrent salamander; RHOL=Olympic torrent salamander.

NEXT STEPS

Next, we will begin formal analysis of amphibian occupancy. We have a large array of habitat and survey condition variables to consider for detection, occupancy, and habitat preferences of target species. Independent variables will likely include stream order, elevation, stream temperature, and other microhabitat variables which include ranges sufficient for several modelling methods. Elevation ranged from 0 to 1,002 m, with most sites occurring between 100 m and 500 m (Figure 5). Stream temperature ranged from 4.1 to 23.8 C, with most falling between 8 and 18 degrees at the time of survey (Figure 6). Using the repeat sampling data we collected in 2019, we will account for detection probability in occupancy and abundance estimates. Our created models, along with our raw results outlined here, will determine the relationships between targeted amphibians and our local environment, which will in turn inform the Aquatic Species Restoration Plan.

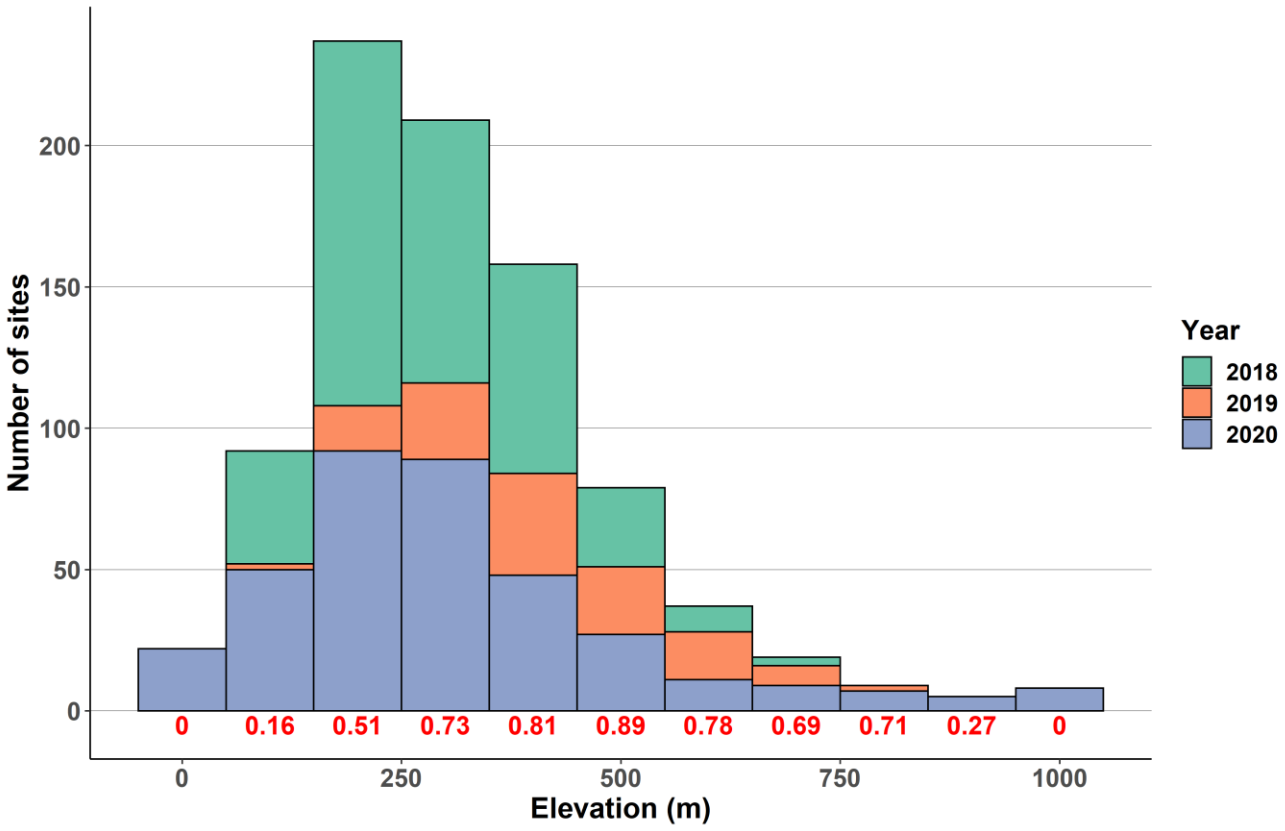

Figure 5. Distribution of 875 unique sites surveyed for stream-associated amphibians in the Chehalis Basin, 2018-2020, by elevation. Red numbers are the proportion of sites in which target amphibians were detected in each bin.

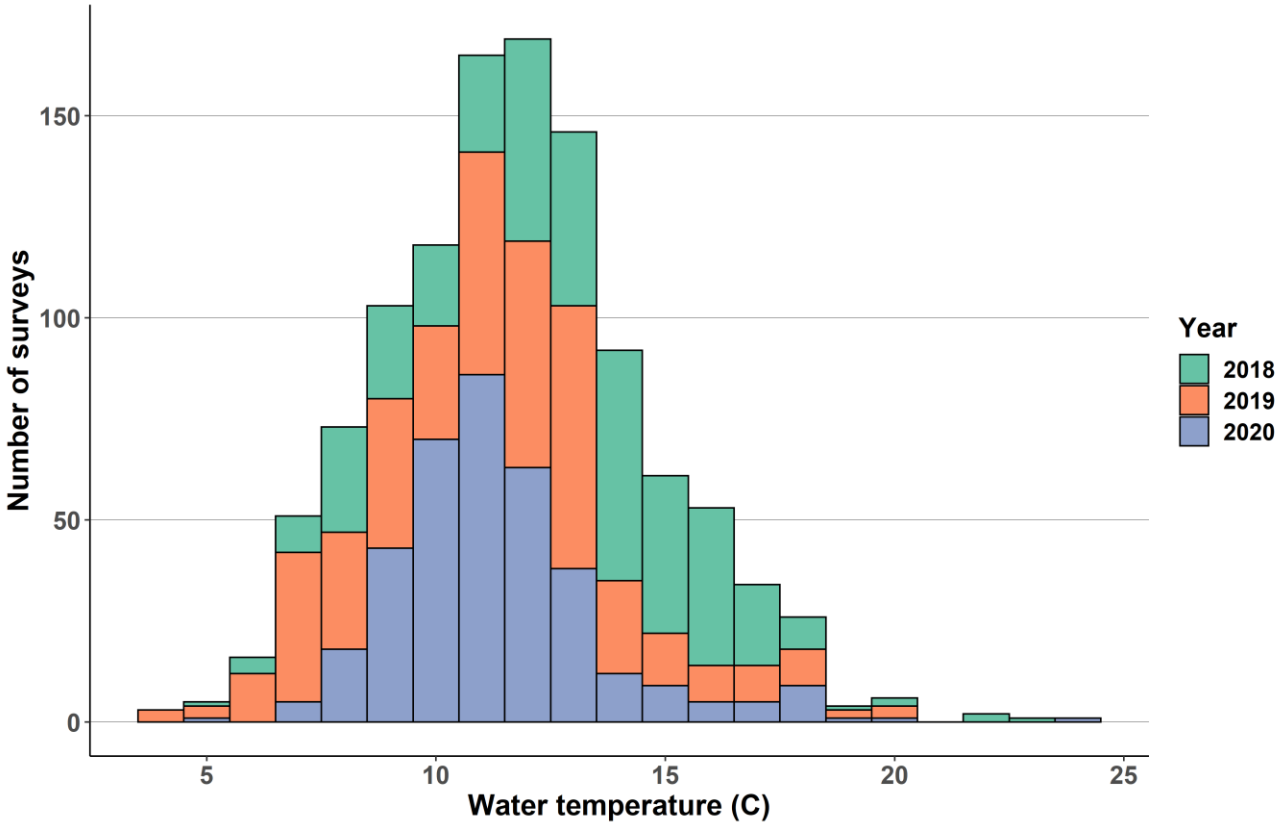

Figure 6. Distribution of 875 unique sites surveyed for stream-associated amphibians in the Chehalis Basin, 2018-2020, by water temperature at the time of survey.